Electronic Version 1.1

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# Description

# ARRANGEMENT FOR DRIVING A WHEEL OF A VEHICLE

## CROSS-REFERENCE TO RELATED APPLICATIONS:

[0001] The present application is a continuation patent application of International Application No. PCT/SE02/01783 filed 1 October 2002 which was published in English pursuant to Article 21(2) of the Patent Cooperation Treaty, and which claims priority to Swedish Application No. 0103713-4 filed 8 November 2001. Both applications are expressly incorporated herein by reference in their entireties.

## TECHNICAL FIELD

[0002] The present invention relates to an arrangement for driving a wheel of a vehicle. More particularly, the invention is directed toward an arrangement that includes a planetary gear transmission having a sun gear connected to a driving axle. A planet carrier is included upon which at least one planet gear is arranged. The planet gear is arranged in engagement with the sun gear, and a ring gear is arranged around, and also in engagement with, the planet gear. A braking device and a wheel hub are also provided. The hub is connected firmly to the planet carrier and the braking device is adapted to brake the planet carrier relative to a static part arranged outside the planet carrier in the radial direction.

[0003] The invention can be applied in vehicles which are intended to be driven on a relatively flat surface, such as a road, and/or on uneven ground in the country.

[0004] The invention is especially applicable to vehicles such as construction equipment pieces (machines) such as wheel loaders, articulated or frame-steered vehicles (what is known as a dumper), and also more traditional land vehicles, such as trucks.

[0005] Such a driving arrangement is usually provided at a wheel arranged at each end of a driving axle, and the gear itself is usually referred to as a hub reduction gear. The driving axle typically

is in two parts, and the parts are connected centrally by a differential gear.

## BACKGROUND ART

[0006] US 6,090,006 describes a driving arrangement comprising (including, but not limited to) a planetary gear transmission. A sun gear of the planetary gear transmission is driven by a driving axle. A number of planet gears are arranged between, and in engagement with the sun gear and an outer ring gear.

[0007] A planet carrier is connected to the planet gears. The ring gear is in turn connected to a pressure plate of a friction brake. The friction brake is arranged so as to brake the planet carrier in relation to an outer, static part. The brake is therefore arranged outside the planet carrier in the radial direction. Inward in the radial direction, the planet carrier is also connected to a portion of a hub via splines. The hub portion is arranged on the inside of, and mounted on the outer static part via two roller bearings. The hub extends outward in the axial direction from the ring gear, and a hub portion on an outer side of the roller bearings is intended to carry the wheel.

## DISCLOSURE OF INVENTION

[0008] One object of the invention is to provide a driving arrangement which is more cost-effective to produce in relation to that which has been previously known. Production according to the present invention includes more cost-effective manufacture and/or less time-consuming assembly. The invention also aims to achieve a driving arrangement that affords opportunities for a reduction of the number of component parts in the arrangement and/or a weight reduction.

[0009] This object is achieved by virtue of the fact that the ring gear and the outer, static part are designed in one piece in the form of an annular member.

[0010] According to a preferred embodiment of the invention, the braking device and the hub are arranged on the planet carrier on different sides of the planet gear.

[0011] In this way, opportunities are afforded for producing a device which is compact; that is to say, requires less space in the axial direction than traditional constructions.

[0012] According to another preferred embodiment of the invention, the hub is mounted against the

annular member and, to be precise, the hub is mounted against the annular member, outside, in the radial direction - that portion of the annular member that forms the ring gear, and also against that portion. In this way, opportunities are afforded for a device which is compact (requires less space) with respect to the axial direction.

[0013] According to another preferred embodiment of the invention, the bearing arrangement between the hub and the gearwheel comprises at least one row of balls arranged along a circular track and also between races designed in the hub and the ring gear. By virtue of such an arrangement, opportunities are afforded for a device that is cost-effective from the point of view of production, and compact in the axial direction.

[0014] Further preferred embodiments and advantages of these emerge from the included description.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will be described in greater detail below with reference to the embodiment shown in the accompanying drawing, and in which:

[0016] Fig. 1 is a schematic diagram, shown as a partly cut-away side view of the driving arrangement.

## MODE FOR THE INVENTION

[0017]

Fig. 1 shows a driving arrangement 1 in a diagrammatic side view. The driving arrangement 1 is arranged at one end of the axle case 3 of a wheel axle 2. A driving axle 4 extends inside the axle case 3. The driving axle 4 is, at one of its ends 5, provided with a hub reduction gear 6 in the form of a planetary gear transmission. At its other end, the driving axle 3 is operationally connected to a central gear (not shown) which, via a drive shaft, is driven by the engine of the vehicle. According to conventional designs, the planetary gear transmission 6 comprises a sun gear 7, a number of planet gears 8 and a ring gear 9 which are arranged in driving interconnection via teeth. The ring gear 9 is connected firmly to the axle case 3 via screw joints 10. A planet carrier 11, also known as a planet gear holder, is adapted so as to hold the planet gears 8. To be precise, the planet gears 8 are mounted on the planet carrier 11. The number of planet gears 8 in the preferred embodiment is three; but, it is contemplated that devices will fall within the scope of the present invention regardless of the number of planet gears which can be

one, two, three, four and more.

[0018] A hub 12, intended to carry a wheel (not shown), is mounted outside the ring gear 9 in the radial direction, and also against it. The wheel hub 12 is also connected firmly to the planet carrier 11. In the illustrated exemplary embodiment, the hub comprises an annular part 13 and a disk-shaped cover 14 connected firmly to the annular part 13. The annular part 13 is arranged outside the ring gear in the radial direction and is also mounted thereagainst. The annular part 13 and the disk-shaped cover 14 are interconnected firmly via screw joints 15.

[0019] The cover 14 is arranged outside the planetary gear transmission 6 in the axial direction and protects the latter from the external environment. The hub 12, and to be more precise, the cover 14 is connected firmly to the planet carrier 11. The wheel is fastened by a conventional fastening device (not shown) on the hub 12, usually a bolt joint.

[0020] The driving arrangement also comprises a braking device 16. The braking device 16 is configured as a wet brake in the form of a multiple-disk brake. The braking device 16 comprises two sets of brake disks that rotate in relation to one another during operation. A first set of brake disks is connected to a static part 18 arranged outside the planet carrier 11 in the radial direction. The connection consists of a spline joint 17. A second set of brake disks is connected to the planet carrier 11. The connection consists of a spline joint 19. The brake disks are displaceable in the axial direction on the spline joints 18,19. In a conventional manner, the brake disks belong alternately to the first set and to the second set. The planet carrier 11, which is connected firmly to the hub 12 and thus has the same speed as the wheel during operation, is in this way braked against the static part 18.

[0021] The braking device 16 also comprises a brake piston 26 for applying the brake by pressing the brake disks together and thus increasing the friction between them.

[0022] A duct 27 is provided to supply oil for applying the brake and is coupled to the brake piston. On an opposite side of the brake disks relative to the brake piston 26, the annular member 20 forms a pressure surface, or stay, against which the disks are brought into contact with when the brake is applied.

[0023] By means of this type of braking device 16, the wheel is braked directly. By virtue of the fact that

the wheel is braked directly - that is to say, the braking takes place after the planetary gear transmission 6, a part is braked which has a lower rotation speed relative to the driving axle (the driving axle usually has a speed which is approximately six times higher than that of the wheel). In this way, it is possible to obtain very good adjustability of the braking, which is especially advantageous for application in vehicles which require great braking power within a large speed range. Exemplary incorporating vehicles include, for example, dumpers, other types of construction equipment and overland vehicles.

[0024] The ring gear 9 and the outer, static part 18 are designed in one piece in the form of an annular member 20. In other words, the ring gear 9 and the outer, static part 18 are integrated in the annular member 20.

[0025] The annular member 20 has a number of functions including: acting as a holder for the planetary gear transmission 6, which is to say, the member 20 is connected firmly to the axle case 3; acting as a brake housing for the braking device 16; and acting as a bearing unit 21 for mounting the wheel hub 13. The annular member 20 can be described as comprising a first annular portion 9, in the form of the ring gear, that is arranged in a first position in the radial direction. The annular member 20 also includes a second portion 18, in the form of the outer, static part, that is arranged in a second position at a greater distance in the radial direction than the first portion. The annular member 20 also comprises a portion 22 which lies between the first and second portions and forms the pressure surface for the brake disks, which intermediate portion 22 extends in the radial direction and connects the ring gear 9 and the outer, static part 18.

[0026] The bearing arrangement 21 between the hub 13 and the ring gear 9 comprises a row of a number of balls arranged along a circular track between races designed in the hub 13 and the ring gear 9. Such a bearing arrangement is often referred to as a four-point bearing due to the fact that four surfaces are ground for contact with the balls. In order to form the bearing arrangement, a number of balls are therefore mounted in between the ring gear 9 and the hub 13. In other words, there is no conventional ball bearing between the parts. In the instant context, the term “race” is utilized to mean that a surface area is designed for receiving the balls. This surface area usually has a curved or angled shape.

[0027] The member 20 which comprises the ring gear 9 and the outer, static part 18 has been described as "annular" and should be taken in a wide sense in that the term, as utilized herein, includes various forms of at least essentially circular structures that are continuous in the peripheral direction.

[0028] The braking device 16 and the hub 13 are arranged on different sides of the planet gears 8. More precisely, the braking device 16 is arranged on the planet carrier 11 for direct braking thereof relative to the annular member 20. The hub 13 is in turn connected firmly to the planet carrier 11. The planet gears 8 are mounted on pivots 24 which project from the disk-shaped cover 14. That part 25 of the planet carrier 11 which forms the brake housing is connected to the pivots 24 via screw joints 23. According to an alternative embodiment, the planet carrier part 24 and the brake housing part 25 are formed in one piece.

[0029] The invention is not to be regarded as being limited to the illustrative embodiments described above, but a number of further variants and modifications are conceivable and contemplated to be within the scope of the patent claims. For example, application or utilization of the arrangement may differ, or the engine of the vehicle may be arranged so as to drive the driving axle 4 directly, that is to say without an intermediate drive shaft and central gear.

[0030] Figure 1 shows the bearing arrangement in the form of a row of balls which are received in races in the hub and the ring gear. Alternatively, it is possible to utilize a number of rows of balls, which rows are arranged with a mutual spacing in the axial direction. This type of bearing arrangement is usually referred to as an angular contact bearing. According to another alternative, other types of bearing arrangements can be used, such as roller bearings and, in particular, conical roller bearings.